Artificial Intelligence Technologies: Applications, Threats, and Future Opportunities

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Abstract

Artificial intelligence's (AI) rapid evolution has made it a critical technology in medicine, education, research, computer vision, natural language processing, automatic driving, robotics and automation, and other fields such as retail (marketing) services across all industries. It has experienced notable advancements in these areas over the past decade giving rise to numerous future opportunities, and associated challenges. Furthermore, artificial intelligence systems have an impact on work efficiency and activities in industries. While artificial intelligence is being positively embraced by sectors such as healthcare, education, industries, and marketing service providers, its application provides both opportunities and challenges. Rapid advances in artificial intelligence and related technologies will assist service providers in creating new value for their customers, while also improving the effectiveness of their operational processes. Efficient deployment of artificial intelligence requires planning and tactics to transform the needed technologies. This study investigates the state of artificial intelligence-based technological applications and their impacts on various sectors such as healthcare, education, and marketing (retail) industries. The results indicate that the healthcare, education, and marketing industries at present are using artificial intelligence-enabled systems to perform different activities for a wide range of services. Furthermore, the authors present the future opportunities derived from AI technologies and associated threats in the various sectors reviewed.

Keywords

Artificial Intelligence, Deep Learning, Future Opportunities, Machine Learning, Threat.

1. Introduction

Artificial intelligence (AI) has advanced at an exponential rate in recent years. Artificially intelligent technologies can sift through and interpret massive amounts of data from various sources in order to perform a variety of tasks [1], [2]. To improve quality of life and operational efficiency, healthcare, education, and marketing service providers around the world, particularly in developed economies, are aggressively deploying digital technologies such as artificial intelligence (AI), machine learning (ML), big data analytics, smart sensors and robots, and the Internet of Things (IoT) [3-5]. AI-based technologies, such as ML, natural language processing, and smart robots, offer tremendous prospects for innovation in knowledge-intensive industries [6]. The term "Artificial Intelligence (AI)" refers to machine intelligence. It has grown increasingly popular in recent years, and is now used to learn and emulate human behavior. These machines are capable of learning from their mistakes and perform functions similar to those performed by humans. As AI advances, it will have a huge impact on our quality of life [7-10] and AI-based models which have been trained using large amounts of data are capable of making intelligent decisions [11-14]. Machine learning is an aspect of AI that focuses on the

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implementation of AI technologies in various applications. The goal of ML is to continuously learn from new data to make predictions or perform actions without the need for explicit conversion. Researchers began exploring the potential of creating a consultation machine in the 1940s, and AI research began in earnest in the 1950s. The study in [16] has been hailed as a fundamental philosophical argument for AI decision-making. The creation of computer algorithms that can compete with human reasoning in essential games like checkers and chess, for example, is a top priority. AI research has gotten a lot of attention since then, particularly following three triumphs. Deep Blue, IBM's first triumph, was the largest chess car capable of defeating the world chess champion [17]. The work in [18] was the second achievement, while the third achievement was an AI chess player that achieved a high level of play after only 24 hours of play and defeated the best human chess player in 2017 [19].

These descriptive moments have served as motivation for the tremendous breakthroughs in AI and its applications in ML over the last two decades, attracting considerable resources to AI research and development. Some organizations, for instance spent $26 to $39 billion on AI in 2016, which was the same as in 2013 [20]. Supply chains have frequently aided in the gain of new investments and interests in operational implant technologies. Product distribution, web hosting, remote development, and intelligent sensors are examples of high-level data frameworks that have become significant drivers of corporate development. Business cycles and supply networks, even in different enterprises and topographies are currently thought to be constantly linked [21]. In the business sector, AI applications have improved job profitability by allowing for easy understanding and anticipation of consumer interests, thanks to cutting-edge technology and robotization.

The expected value of AI, according to McKinsey's new report, is $3.5 to $5.8 trillion, with $0.2 to $0.3 billion allocated to medical care management, $0.7 to $1.0 billion allocated to integration (automotive collection, advanced gadgets, and semiconductors, as well as advanced integrated design), and $0.4 to $0.8 billion allocated to sales [22], [23]. ML applications have shown capability to fully reduce healthcare costs (up to $300 billion annually), improve online deals (up to 30%), improve stock (up to 50%), improve delivery (up to 30%), and improve natural product quality (up to 10%) [20], [23].

While the automobile industry and new organizations began to lead the pack in AI adoption, retail and healthcare establishments, where AI could deliver more profits, established pricing that was generally limited and low [21]. Some industries, such as automotive, telecommunications, and healthcare, have reaped greater benefits from AI implementation than others [24]. Similarly, different industries use different AI applications. Clear barriers of adoption have been identified in less digitally mature sectors, including both internal (e.g., cultural resistance, lack of skills, financial considerations) and external barriers (e.g., lack of venture capital). The challenges of AI adoption are mostly comparable to those that hamper digitalization, especially for medium-sized businesses. Adoption of such AI applications are predicted to have a variety of positive consequences on individual businesses, value chains, and social and macroeconomic levels. Therefore, in this study, we examine the current state of artificial intelligence-based technological applications and their impact is on healthcare, education, and marketing (retail) industries.

This paper is structured as follows. Section 2 presents the application of AI technologies. Section 3 presents the threats and opportunities of AI. Section 4 presents the rise of AI, overall future outlooks, and new risks. The conclusion of the paper is presented in section 5.

2. Applications of Artificial Intelligence Technologies

2.1. AI in Healthcare Services

The most effective use of medical artificial intelligence is to provide solutions that medical experts cannot achieve [25]. AI technologies are rapidly taking over the healthcare sector. AI has aided the transformation of the manual healthcare system into an automated one. The technical difficulties of digitizing healthcare presents new issues when developers create AI systems to perform tasks [26], [27]. Furthermore, increase in population is expected to increase the demand for healthcare services. The healthcare sector requires creative solutions to become more effective and efficient without incurring excessive costs [27].

The healthcare sector can benefit from quick technological breakthroughs, notably in the fields of AI and robotics. AI and robotics in healthcare are quickly developing, especially for applications in early detection and diagnostics. AI has become more powerful by successfully completing in human tasks more quickly, easily, and economically. The use of AI also comes with it various hazards and difficulties, such as the risk of patient harm from system flaws, patient privacy issues when acquiring data and others. AI is essential for early detection and diagnosis, and it is applied in numerous ways to reliably, consistently, and swiftly detect diseases like cancer. Simply, it autonomously learns and detects associations and recommends a diagnosis. Because AI has demerits, the future of AI in healthcare is not entirely optimistic. Numerous questions have arisen regarding whether AI can exercise doctors' rights and obligations, as well as protect privacy concerns, and the applicable laws are not fully prepared for this advancement. Although it appears that present laws encourage AI given its application in the global healthcare system. It has been established that guidelines for the creation, modification, and use of technology and health technology products to medical care are available. Online processes to acquire therapeutic knowledge have been established for many applications, such as a procedure or schedule of a medical procedure, symptomatic screening, and the diagnosis and prediction of certain disorders [28]. For example, the IBM AI analyzes mammographic images and clinical records to predict a specific disease a year ahead of time with 87% accuracy, incorporating dysfunction, thyroid strength, biopsies, laboratory tests, and codes from multiple findings was presented in [29]. Also, for sugar IQ, a diabetic management software that employs an algorithm was developed to adjust blood glucose levels, insulin profiles, hypoglycemia scores, and dietary supplements to give clients the glucose experience they expect and anticipate was presented in [30].

2.2. AI in Educational Services

The emergence of innovative technologies in the educational sector has an impact on the methods of teaching and learning [31, 32]. With the rapid development of AI technology in recent years, its use in education has become important, especially during the COVID-19 pandemic [33-35].

2.2.1. Student needs can be adapted to educational software

One of the most important installations that can aid effective participation and learning in primary, secondary, and tertiary institutions is the use of advanced software to acquire tailored knowledge in one of the preceding styles with the use of apps, games, and software [36].

2.2.2. AI can identify areas in which courses need to be improved

Teachers most times may not be aware of gaps in communication while teaching their courses and in teaching materials given to students. AI offers can be made to offer solutions to these difficulties [36].

2.2.3. AI can help students with additional tutors

Educational tools, particularly those geared toward artificial intelligence, are now available to help college students with math, writing, and other subjects [36].

2.2.4. Students and instructors can benefit from AI-driven programs

AI can give feedback on the overall effectiveness of the classes in addition to assisting teachers and students in developing lessons that are tailored to each individual's needs. Some universities, especially those that offer internet services, use AI systems to monitor student progress and notify instructors/teachers when a problem arises with their students' performance [36].

2.2.5. AI is changing the way we find and use information

Non-intelligence agencies that have an impact on the records we view and receive daily are most times not discussed in literature. For instance, Google adjusts to customer requirements and orders, Amazon prepares recommendations based on prior purchases, Siri adapts to customer needs and orders, and nearly all online adverts are personalized to customer hobbies and purchasing interests [36].

2.2.6. The role of teachers could be changed by AI

Educators have a part in training students, although this job and what it entails can be altered by a new generation standing on the shoulders of smart computing programs. AI, as we have pointed out, can take on tasks such as grading, it can assist college students in developing abilities, and can be used as another real worldwide teaching tool. The AI programs can be created to deliver information, serve as a forum for college students to ask questions and learn facts, or provide a basic guideline for the teacher. AI, on the other hand, may in extreme situations shift the instructor's role to that of a facilitator.

2.2.7. AI can make trial-and-error learning easier

Despite the fact that trial and error is an important part of learning, many students are afraid of failing or losing their grasp on a solution. As humans, most people don't want to learn from mistakes.

2.2.8. AI-based data can change the way schools find teachers and support students

Intelligent data collection aided by clever computer systems have altered the way schools connect with prospective students in the past and present. AI has been useful from hiring teachers to assisting college students in selecting suitable guides to help achieve the students' desires and dreams.

2.3. AI in retail (marketing) services

A wide range of marketing researchers have recently become intrigued by AI [37]. Their research advances this developing field by taking a global perspective on AI marketing tools. Three levels of analysis, country, company, and consumer were the focus of their study. The country-level analysis highlights how different levels of economic inequality exist between nations due to the significant financial resources needed for AI implementation. Globalization is the main emphasis of the company-level evaluation. Because the hardware supporting these technologies is worldwide in scope, cultural adaptation is necessary for their implementation. The consumer-level analysis looks at consumer ethics and privacy concerns, as AI technologies collect, store, and process a plethora of personal data from all over the world. The researchers focused on two important dimensions of AI technologies in marketing through the prism of these three lenses: (1) human-machine interaction, and (2) automated analysis of text, audio, images, and video. They use a three-part global perspective to explore the relationship between these two important dimensions of AI and provide a set of research questions for future marketing enthusiasts in this burgeoning sector. In marketing as well, rational ingenuity is employed. Electronic shopping allows online businesses to collect massive amounts of data about purchases, bushels, and, events, design processes. This data offers merchants information on future expectations, advancements, and aid with store network operations, stock satisfaction, and delivery structures. For example, Walmart utilizes a ML picture algorithm named "Eden" in-group products for their brand which predicts when it would go bad [38]. Home Depot uses critical thinking to foresee stock market possibilities and robotics in stock options, whereas the Kroger Company is attempting to develop a more limited approach to distribution center testing to fulfill client requests [38].

Some traditional merchants have begun to offer basic food products for delivery to competing internet retailers. Amazon Fresh, Instacart, Peapod, and Tesco, for example, provide essential products to their online customers. Developing a competent e-staple distribution system necessitates addressing many concerns, including issues of stochastic setting arrangements with user experience, a targeted vehicle that directs issues through time windows, and stock management issues. This problem structure is not limited to e-goods as it also applies to other end-to-end services such as home health care delivery, logistics, and institutional management, as well as some home management services such as gas, energy, and water [39]. Home management, while being the most expensive, polluting, and inefficient production network activity provides consumers with a wide range of focus areas, such as a wide selection of commodities, price comparisons between E-food feeds, and easy sales imports [40]. A review of research on AI technologies in marketing is vital, according to [37], with an emphasis on whether the studies take into account these two aspects of AI (HMI and automated analysis), as well as the aspects of its global lens of inequality, globalization, ethics, and privacy.

3. The threats and opportunities of AI

Applications of AI can increase value by personalizing goods, enhancing customer service, and helping to create new product categories, business models, and even industries. AI applications also benefit the workforce (such as improved workplace safety) and are expected to provide significant societal and economic-wide benefits in addition to the firm-level benefits and prospects. Significant increments in productivity, innovation, growth, and job creation have been predicted using AI in recent times. Labor productivity is expected to rise by 11-37% by 2035, according to [24]. Furthermore, AI is predicted to favorably contribute to the United Nations Sustainable Development Goals, and the capabilities of AI and ML to handle important health concerns, such as the present COVID-19 health epidemic, are remarkable [24]. AI systems, for example, has the potential to shorten the time it takes to develop vaccines and drugs. However, implementing AI is fraught with difficulties. Although AI has significant advantages for the workforce, it is clear that a large number of professions will be eliminated or not be useful as a result of AI. Although this will free up human resources for roles requiring higher levels of competence, workforce adaptation in the form of education and retraining is essential because those who are displaced frequently lack the skills necessary to take advantage of AI-driven job creation. Furthermore, when it comes to AI adoption, SMEs confront specific hurdles, whereas large organizations are better positioned to profit on AI's opportunities. This could lead to a market overconcentration of major enterprises. Significant ethical and legal issues also exist, including those relating to the security of AI systems, data privacy and protection, transparency and accountability, discrimination, justification, and responsibility. Given its potential, governments everywhere are engaged in a fierce race in AI, driven by worries about geopolitics, the economy, and technology [37]. When it comes to the United States and China, each has a unique balance of strengths. For example, the European Union and the United States are nearly equal and ahead of China in terms of AI expertise and research skills, however Europe trails in terms of venture capital funding, practical use, and hardware development. The European Union, on the other hand, has long enjoyed competitive advantages in many critical areas, including automotive, healthcare, energy, and agriculture, and is well-positioned to capitalize on emerging waves such as big data. Sections 3.1-3.5 examines AI's future opportunities.

3.1. Effects of movement and re-establishment

Personnel in stock chains are affected by measurement, equipment use, and the effects of mechanical technology. The authors in [41], claim that employment replacement is driving this new development, which has resulted in severe effects on the economy. They claim that unless the extinction effect is equated with all of the forces of resistance known as the reverberation effect (the creation of new jobs), the economy's profits will not be sustainable, and monetary reform will not progress.

A productive workforce with high and consistent wages is required for reasonable financial progress. High unemployment encourages people to spend less, which affects businesses that manufacture goods and provide a variety of services to workers. What new jobs could be created in such situations to compensate for the commitment to look for work? AI will almost certainly continue to supplant a few man-made inventions and computer-assisted attempts, for example confession, decision-making, communication, and power [41]. In [42], complexity, judgment, relationship-based learning, original thinking, and a mix of actual labor, empathy, and correspondence [43] present new nonprofit intelligence agencies. For example, the following are some of the new job titles:

"Trainers" who teach the algorithm,

 "Interpreters" who reveal non-technical intelligence decisions, and

"Sustainers" who probe the effectiveness of artificial intelligence.

3.2. AI's Accountability and Trust

The AI programs currently operates in a short-term unmanaged context, despite its numerous advantages. An atmosphere of climate change is created when there are no guidelines, and lucrative commercial organizations are encouraged to speed the design of inventive technologies, while investing little energy in vital testing to safeguard customers from harm and diverse litigations [44]. If the

consumer is harmed by new equipment, the problematic guide makes it difficult to discover a legal object or defense from the provider to keep it operational [21]. For example, if a self-regulating vehicle collides with a fender bender, or if a patient is misdiagnosed due to inappropriate chemical treatment, how should a researcher handle himself? In this case, it is clear artificial intelligence has its own shortcomings. To address some of the challenges, some ethical and practical recommendations have been made in papers for governing design firms and to guide the numerous goods that produce and use superior technology improvements. The findings stress the significance of explicit local norms, as well as direct understanding and commitment to the entire artificial technology development network [44]. The majority of ML algorithms, which are primarily based on neural associations, act as cryptic cues, allowing a large number of iterative statistics in large databases to undo the model's limitations, eventually collecting or predicting data according to a predetermined task [43], [45]. While algorithm design can be tested and justified, information enthusiast are usually unable to provide a precise characterization of artificial intelligence's fundamental functions [43]. To address this issue, the European Union Parliament passed the General Data Protection Regulation in 2016, which grants customers the opportunity to challenge a robotic framework's judgment [45], [46].

3.3. Security of Information and Customization

To sustain interest in personalized content and administration, chains must be able to collect, store, and distribute enormous amounts of personal data, both organized (name, address, and a unique number of details, for example) and random (posts, tweets, photos, and recordings, etc). To ensure effective storage and security of information, enterprises must engage considerably in data creation. Because of the financial implications of the exchange, rather than buying, chain stores frequently reconsider such abilities in collaboration with new enterprises. New businesses, unlike huge enterprises, frequently require costly knowledge bases. Nowadays, small start-up organizations are paying major companies to obtain technological capabilities, just as they are paying huge companies to acquire large data stocks and computing capacity.

3.4. The Effects of Robotics and AI on Future Jobs

More recently, robotics and AI have reached incredible global cooperation for a variety of objectives. Robotics' growing popularity and prominence makes living easier [47], [48]. At the same time, when robots take over all of the jobs in the industrialized sector, there will be a reduction of human labour. While robots boost efficiency, they also reduce job prospects. All blue-collar jobs have been taken over by robots. Robots are now making inroads into white-collar occupations. Robots, man-made companions, can perform low-paying labor during non-social hours, while providing immense comfort to the globe. Future generations are likely to perceive the robot as a teacher and caregiver after it learns feelings like compassion and advanced reaction detection [49], [50], [51]. According to [52], since robots make everyone's life easier and more comfortable, human-robot interaction is gradually gaining ground.

4. The Rise of AI, Overall Future Outlooks, and New Threats

A facility's cleverness, mechanical technology, and computing efficiency appear to be beyond the ability to integrate such things as computer hardware, autos, and consumer gadgets, similar to medical care, marketing, education, criminal equality, housing, and banking [52]. These advancements will continue to give businesses and customers a wide range of appealing and open environments, such as increased productivity, increased customization, higher quality, and longer lead times. Nevertheless, there are obstacles to overcome in life. These issues include, but are not limited to, the division of labor by human instructors, the simultaneous development of human and robotic safety, the construction of a framework to ensure robotic systems, and the development of artificial insemination technologies to build confidence [54].

AI and technological advancements compel huge changes, and institutions and testing organizations play a critical role by adjusting to these developments. Typically, educational frameworks are created to foster local technological development. After all, the implant's creativity was once evaluated by computer programs and a real-life learning environment. AI has gained great value in the recent two

decades, regardless of its specifics. The work in [53] proposed that both intellectual and non-intellectual intelligence systems should evolve beyond science and design constraints to make people more inclusive. As a result, colleges should take the lead in managing this multi-sectoral field of view, as businesses are in desperate need of social and specialized skills that can operate in scientific teams made up of experts from several fields in unison [53]. Workplaces which use AI technologies have altered they way people think and carry out work allowing employees with a variety of skills to cooperate, trade data, and produce spectacular ideas and results. It is now time to modify people's attitudes and ideas regarding AI, ML, and high-tech equipment, beginning with the educational system, particularly the way examinations are being conducted. Accordingly, AI's rapid evolution has made it a critical component of business in all industries and the advantages of AI in managing cybersecurity risks are evident [54].

5. Conclusion

Over the last two decades, AI and ML applications have witnessed unprecedented developments. AI has improved robotics and automation, which has a significant impact on many aspects of a company, particularly in healthcare, education, and retail (marketing) services. AI also has an impact on a wide range of social and industrial sectors, including rational design, medical care, educational service, and retail (marketing) services, as well as smart urban planning, transportation, and maintenance. In this paper, a critical review of AI applications, future opportunities, and threats was presented. In addition, the paper also discusses how AI-enabled technologies are being used in the healthcare, educational, and retail (marketing) sectors including their threats and opportunities.

References

[1]   D. Hee Lee and S. N. Yoon (2021). Application of AI-based technologies in the healthcare sector: Opportunities and challenges, International Journal of Environmental Research and Public Health, vol. 18, no. 1, pp. 1–18, doi: 10.3390/ijerph18010271

[2]   S. Sunarti, F. Rahman, M. Naufal, M. Risky, K. Febriyanto, R. Masnina, and G. Sanitaria (2021). Artificial intelligence in healthcare: potential and danger for the future, vol. 35, pp. 67-70, doi: 10.1016/j.gaceta.2020.12.019.

[3]   T. Davenport and R. Kalakota (2019). The potential for artificial intelligence in healthcare," *Future Healthcare Journal*, vol. 6, no. 2. pp. 94–98, doi: 10.7861/futurehosp.6-2-94.

[4]   S. J. Anderson, P. Chintagunta, F. Germann, and N. Vilcassim (2021). *Do Marketers Matter for Entrepreneurs? Evidence from a Field Experiment in Uganda. Journal of Marketing, 85(3), 78–96.* doi: 10.1177/0022242921993176

[5]   D. A. G. D. G. T. Bressgott, "How artificial intelligence will change the future of marketing _ Enhanced Reader.pdf." pp. 24–42, 2020.

[6]   S. Secinaro, D. Calandra, A. Secinaro, V. Muthurangu, and P. Biancone (2021). *The role of artificial intelligence in healthcare: a structured literature review. BMC Medical Informatics and Decision Making, 21(1).* doi: 10.1186/s12911-021-01488-9

[7]   M. C. T. Tai, "The impact of artificial intelligence on human society and bioethics," *Tzu Chi Med. J.*, vol. 32, no. 4, pp. 339–343, 2020, doi: 10.4103/tcmj.tcmj_71_20.

[8]   E. Economic and and S. Committee, "Artificial intelligence can improve quality of life but potential risks remain _ European Economic and Social Committee." .

[9]   D. South, "How Artificial Intelligence Can Improve Knowledge Management."

[10]   H. Essoussi, "Implications of Artificial Intelligence on Quality of Life (A Prospective Study of the Advanced Technological Reality and the Vague Human Future)," vol. 3, no. 1, pp. 1–7, 2019, doi: 10.5923/j.ijire.20190301.01.

[11]   A.M. Ayalew, A.O. Salau, B.T. Abeje, B. Enyew, "Detection and Classification of COVID-19 Disease from X-ray Images Using Convolutional Neural Networks and Histogram of Oriented Gradients," *Biomedical Signal Processing and Control*, 103530, vol. 74, pp. 1-11. DOI: 10.1016/j.bspc.2022.103530

[12]   A.O. Salau, "Detection of Corona Virus Disease Using a Novel Machine Learning Approach," *2021 International Conference on Decision Aid Sciences and Application (DASA)*, pp. 587-590, 2021. DOI: 10.1109/DASA53625.2021.9682267.

[13] J. Bajwa, U. Munir, A. Nori, and B. Williams, "Artificial intelligence in healthcare: transforming the practice of medicine," *Futur. Healthc. J.*, vol. 8, no. 2, pp. e188–e194, 2021. DOI: 10.7861/fhj.2021-0095.

[14] A.O. Salau, S. Jain, "Adaptive Diagnostic Machine Learning Technique for Classification of Cell Decisions for AKT Protein," *Informatics in Medicine Unlocked,* vol. 23, no. 1, pp. 1-9, 2021. DOI: 10.1016/j.imu.2021.100511.

[15] S. Mao, B. Wang, Y. Tang, and F. Qian, "Opportunities and Challenges of Artificial Intelligence for Green Manufacturing in the Process Industry," *Engineering*, vol. 5, no. 6, pp. 995–1002, 2019, doi: 10.1016/j.eng.2019.08.013.

[16] A. M. Turing, Computing Machinery and Intelligence "*Mind*," vol. LIX, issue 236, pp. 433–460, 1950. DOI: 10.1093/mind/LIX.236.433

[17] M. Campbell, A. J. Hoane, and F. H. Hsu, "Deep Blue," *Artif. Intell.*, vol. 134, no. 1–2, pp. 57–83, 2002, doi: 10.1016/S0004-3702(01)00129-1.

[18] D. Silver *et al.*, "Mastering chess and shogi by self-play with a general reinforcement learning algorithm," *arXiv*, pp. 1–19, 2017.

[19] P. Parenti *et al.*, "No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title," *J. Sains dan Seni ITS*, vol. 6, no. 1, pp. 51–66, 2017.

[20] E. H. Paris, S. R. Washington, M. Chui, S. Francisco, and T. A. London, "Artificial Intelligence the Next Digital Frontier ?," pp. 1–80, 2017.

[21] R. Adixon, "Artificial Intelligence Opportunities & Challenges in Businesses | by Robert Adixon | Towards Data Science." 2019.

[22] J. Bughin, J. Seong, J. Manyika, M. Chui, and R. Joshi, "Modeling the global economic impact of AI | McKinsey," *McKinsey*, no. September, pp. 1–61, 2018.

[23] A. K. Dogru and B. B. Keskin, "AI in operations management: applications, challenges and opportunities," *J. Data, Inf. Manag.*, vol. 2, no. 2, pp. 67–74, 2020, doi: 10.1007/s42488-020-00023-1.

[24] J. Eager, M. Whittle, J. Smit, G. Cacciaguerra, and E. Lale-demoz, "Opportunities of Artificial Intelligence Policy," *Ipol*, vol. 1, no. 6, pp. 1–99, 2020.

[25] W. N. Price II, "Risks and remedies for artificial intelligence in health care," *Brookings*. 2019.

[26] G. Rong, A. Mendez, E. Bou Assi, B. Zhao, and M. Sawan, "Artificial Intelligence in Healthcare: Review and Prediction Case Studies," *Engineering*, vol. 6, no. 3, pp. 291–301, 2020, doi: 10.1016/j.eng.2019.08.015.

[27] R. Manne and S. C. Kantheti, "Application of Artificial Intelligence in Healthcare: Chances and Challenges," *Curr. J. Appl. Sci. Technol.*, no. May, pp. 78–89, 2021, doi: 10.9734/cjast/2021/v40i631320.

[28] A. Biswal, "AI Applications: Top 14 Artificial Intelligence Applications in 2022," *Simplilearn*. 2022.

[29] M. B. Morgan and J. L. Mates, "Applications of Artificial Intelligence in Breast Imaging," *Radiologic Clinics of North America*, vol. 59, no. 1. pp. 139–148, 2021, doi: 10.1016/j.rcl.2020.08.007.

[30] M. Lisa Latts, "Alleviating the Burden of Diabetes with AI," 2019. https://www.ibm.com/blogs/think/2019/01/alleviating-the-burden-of-diabetes-with-ai/

[31] S. Biju, A. O. Salau, J. N. Eneh, V. E. Sochima, I. T. Ozue, "A Novel Pre-Class Learning Content Approach for the Implementation of Flipped Classrooms," *International Journal of Advanced Computer Science and Applications (IJACSA)*, vol. 11, no. 7, pp. 131-136, 2020. DOI: 10.14569/IJACSA.2020.0110718

[32] G. Melli, "The Role of Artificial Intelligence in the Future of Education | GetSmarter Blog," *Harvard get smarter*, no. 5. pp. 65–67, 2019.

[33] J. Huang, S. Saleh, and Y. Liu, "A review on artificial intelligence in education," *Acad. J. Interdiscip. Stud.*, vol. 10, no. 3, pp. 206–217, 2021, doi: 10.36941/AJIS-2021-0077.

[34] S. F. Ahmad, M. M. Alam, M. K. Rahmat, M. S. Mubarik, and S. I. Hyder, "Academic and Administrative Role of Artificial Intelligence in Education," *Sustain.*, vol. 14, no. 3, pp. 1–11, 2022, doi: 10.3390/su14031101.

[35] G.-J. Hwang, H. Xie, B. W. Wah, and D. Gašević, "Vision, challenges, roles and research issues

of Artificial Intelligence in Education," *Comput. Educ. Artif. Intell.*, vol. 1, pp. 2–6, 2020, doi: 10.1016/j.caeai.2020.100001.

[36] T. Staff, "10 Roles For Artificial Intelligence In Education." pp. 1–9, 2015.

[37] P. K. Kopalle, M. Gangwar, A. Kaplan, D. Ramachandran, W. Reinartz, and A. Rindfleisch, "Examining artificial intelligence (AI) technologies in marketing via a global lens: Current trends and future research opportunities," *Int. J. Res. Mark.*, no. xxxx, pp. 1–19, 2021, doi: 10.1016/j.ijresmar.2021.11.002.

[38] F. Weber and R. Schütte, "A domain-oriented analysis of the impact of machine learning—the case of retailing," *Big Data Cogn. Comput.*, vol. 3, no. 1, pp. 1–14, 2019, doi: 10.3390/bdcc3010011.

[39] B. P. Bruck, J. F. Cordeau, and M. Iori, "A practical time slot management and routing problem for attended home services," *Omega (United Kingdom)*, vol. 81, pp. 208–219, 2018, doi: 10.1016/j.omega.2017.11.003.

[40] J. F. Ehmke and D. C. Mattfeld, "Vehicle Routing for Attended Home Delivery in City Logistics," *Procedia - Soc. Behav. Sci.*, vol. 39, pp. 622–632, 2012, doi: 10.1016/j.sbspro.2012.03.135.

[41] A. Rai, "Explainable AI: from black box to glass box," *Journal of the Academy of Marketing Science*, vol. 48, no. 1. pp. 137–141, 2020, doi: 10.1007/s11747-019-00710-5.

[42] A. Agrawal, J. Gans, and A. Goldfarb, "Artificial Intelligence, Automation, and Work," *Econ. Artif. Intell.*, pp. 197–236, 2019, doi: 10.7208/chicago/9780226613475.003.0008.

[43] N. J. Nilsson, *The quest for artificial intelligence: A history of ideas and achievements*. 2011.

[44] P. Daugherty and H. J. Wilson, "Process Reimagined," *Accenture*, p. 19, 2018.

[45] M. Whittaker *et al.*, "AI Now 2018 Report," *AI Now*, no. December, pp. 1–62, 2018.

[46] T. Panch, P. Szolovits, and R. Atun, "Artificial intelligence, machine learning and health systems," *J. Glob. Health*, vol. 8, no. 2, pp. 1–8, 2018, doi: 10.7189/jogh.08.020303.

[47] B. Van Alsenoy, "General Data Protection Regulation," *Data Protection Law in the EU: Roles, Responsibilities and Liability*. pp. 279–324, 2019, doi: 10.1017/9781780688459.021.

[48] Salau, A.O., Jain, S. Sood, M. (2022). Computational Intelligence and Data Sciences: Paradigms in Biomedical Engineering. Book published by CRC Press, Taylor and Francis, pp. 1-272, eBook ISBN: 9781003224068. DOI: 10.1201/9781003224068. Available online: https://www.taylorfrancis.com/books/edit/10.1201/9781003224068/computational-intelligence-data-sciences-ayodeji-olalekan-salau-shruti-jain-meenakshi-sood

[49] J. A. Aaron Smith, "AI, Robotics, and the Future of Jobs | Pew Research Center." p. 67, 2014.

[50] S. Kamran *et al.*, "The Impact of Artificial intelligence and Robotics on the Future Employment Opportunities," *Trends in Computer Science and Information Technology*. pp. 050–054, 2020, doi: 10.17352/tcsit.000022.

[51] R. Strack, M. Carrasco, P. Kolo, N. Nouri, M. Priddis, and R. George, "The Future of Jobs in the Era of AI." p. 40, 2021.

[52] Allianz Global Corporate & Specialty, "The Rise Of Artificial Intelligence: Future Outlook And Emerging Risks About Allianz Global Corporate & Specialty," 2018.

[53] J. F. Arinez, Q. Chang, R. X. Gao, C. Xu, and J. Zhang, "Artificial Intelligence in Advanced Manufacturing: Current Status and Future Outlook," *J. Manuf. Sci. Eng.*, vol. 142, no. 11, 2020, doi: 10.1115/1.4047855.

[54] M. Thomas, "7 Ways An Artificial Intelligence Future Will Change The World _ Built In." .